Soybean Production in the Yellowstone Valley

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Soybeans are an important cash crop in many Midwestern states. As new varieties have been developed, soybean acreage in the Dakotas has exploded in recent years. In 1998 Ken Kephart, Superintendent at the Southern Agricultural Research Center (SARC) in Huntley, MT began analyzing irrigated soybean varieties and experimental lines for potential adaptation and production value in the Yellowstone Valley. After four years of analysis the results have been exceptional.

In recent years, the average soybean yield in the seven most productive states (IA, WI, IL, IN, NE, MN, OH) was 41.7 bu/acre with an average protein content of 37.5% and a oil content of 18.9%. Average soybean yield from 1999-2004 at SARC has been 70.9 bu/acre. Protein has averaged 38.9% and oil has averaged 19.0%. Forage soybean varieties have also been tested. Forage varieties tested have had an average forage yield of 5.2 tons/ac with a RFV of 117.4

The data from the SARC trials indicate that irrigated soybeans have excellent potential as both a cash grain and forage crop in the Yellowstone Valley.

Soybean Agronomics

Soil Requirements: Soybean grow best under soil conditions favorable to corn. A fertile, medium-textured loam soil usually is best, however, soybean can be produced on a wide range of soil types. As with most other crops, good drainage is important when growing soybean on fine textured soils.

Rotations: Soybean would fit well into most Yellowstone Valley crop rotations. As a legume, soybean provides a break in the biological cycle of various diseases common to irrigated crops in the Yellowstone Valley. Soybean, if inoculated properly, has the ability to add 1 pound of nitrogen to the soil for every bushel produced. This "free" nitrogen would be very beneficial to a subsequent corn or sugarbeet crop. When malt barley follows soybean, the soil nitrogen levels need to be managed carefully to avoid high protein barley. Soybean should not follow alfalfa or dry beans where white mold (Sclerotinia sclerotiorum) has been detected. Extending a current three-year rotation (beets-barley-corn) to a four-year rotation (beets-barley-soybean-corn) would dramatically assist in controlling current sugarbeet pests such as Sugarbeet Cyst Nematode. It is important to keep accurate records of herbicides used in all crops. Soybean plantback restrictions do exist for some of the currently used herbicides.

Variety Selection: Soybean varieties are classified according to maturity groups that in turn are adapted to maturity zones. Maturity zones are based on day length and accordingly are greatly influenced by latitude. Variety trials at SARC indicate that soybeans in the maturity group range

of 0 – 1.5 have yielded best when grown for grain production, with late 0's being optimum. Maturity group designation is not as critical when growing soybean for forage due to the fact that dry matter production is the goal rather than mature grain production. At this time, resistance to diseases such as Phytophthora root rot, brown stem rot and soybean cyst nematode does not seem to be important in Montana. For SARC variety testing results for both soybean grain and forage production, go to http://www.sarc.montana.edu/ and click on the "Reports" tab or call the Yellowstone County Extension office.

Seed Quality: The selection and use of high quality seed are basic keys to satisfactory soybean yield. Hot, dry conditions during development and maturation may reduce seed size, increase seed injury, and contribute to lowered germination. Select soybean seed that is free of disease, seed coat cracking, splits and green immature seed. Use seed produced the previous year. Seed two years old or older usually has lower germination and less seedling vigor. Care must be taken when handling soybean seed as cracking and seed coat damage can easily occur.

Seed Inoculation: Soybean has the ability to fix nitrogen from the atmosphere if properly nodulated. Inoculating soybean seed with rhizobium bacteria specific for soybean is required before proper nodulation can occur. Several types of inoculum carriers are available for soybean seed treatment. Carriers include peat-based, clay-based, granular, and liquid. Peat-based materials should be applied as a slurry and mixed with the seed. Clay-based materials can be applied dry and will stick to the seed. Clay-based carriers become sticky when wet and can plug planters. Planter boxes should be left empty and cleaned each night when using clay-based products. Granular inoculation materials can be applied separate from the seed through a granular insecticide hopper. Soybean variety trials at SARC have been successfully inoculated with Rhizo-Flo granular inoculant at a rate of 6.5 lbs/ac. Liquid inoculating materials containing soybean inoculum plus a fungicide are available. These products are risky to use due to the fact that fungicides reduce the viability of the inoculum. It is also important to note that good nodulation will not occur in extremely dry fields or in fields with high levels of residual soil nitrogen. Available soil nitrogen will be used in preference to the formation of nodules. Seed planted in fields high in soil nitrogen should always be inoculated to provide a source of rhizobium for future crops.

Seedbed Preparation: Soybean can be grown on a wide range of soil types under various cultural practices. Because of seed size and physiology, soybean seeds require more moisture absorption than cereals for germination. Also, soybean is seeded only 1.5 to 2.0 inches deep. These factors explain why preparation of a firm, uniform seedbed is important for optimum stand establishment.

Shallow spring tillage to kill weeds before planting is effective on fall tilled fields. Spring tillage usually is done just before planting. Several reduced tillage programs can be followed. Many farmers in the Midwest are growing soybean under a no-till program. Special planters or drills may be required to handle surface residue in no-till and some reduced tillage systems. Soybean, like other legume crops, has difficulty emerging through compacted layers and surface crusts.

Fertility: Soybean does best in fertile soil and makes good use of carryover fertilizer. Response to application of commercial fertilizer has been inconsistent in North Dakota research studies. If a soil test of the field indicates low phosphate availability, a band application by planter attachment of 10-30 pounds of phosphate per acre may be beneficial. Approximately 60% of the P and 50% of the K taken up by soybean plants is removed from the field when the seed is

harvested. One bushel of soybean contains about ¾ of a pound of P_2O_5 and over a pound of K_2O per bushel. Starter fertilizer is best placed in a band 2 inches to the side and 2 inches below the seed. Fertilizer placed in direct contact with soybean seed should not be used because stand loss from fertilizer toxicity can result.

Planting Date and Technique: Soybean is susceptible to frost and prolonged exposure to near freezing conditions in spring and fall. Plant soybeans after the soil has warmed up to 50°F and air temperatures are favorable. Planting soybeans more than 5 days before the average last killing frost provides less than a 50 percent chance of frost killing the soybean. A planting date after May 15 will significantly reduce the risk of frost damage.

Seeding can be done with a row crop planter plus proper plates, air planters, grain drills, and air seeders. The seed metering system of grain drills must be adjusted carefully to avoid seed damage. Plant to cover seed 1 ½ to 2 inches deep and place the seed in moist soil.

Seeding Rate and Row Spacing: SARC soybean variety trials indicate that plant populations of 200,000 – 220,000 plants per acre resulted in the highest yields when planted on 6-inch rows (solid seeding). Depending on seed size, this population is generated by planting 70-75 pounds of seed per acre. Solid seeded soybean will produce satisfactory yields only if the land is relatively free of weeds, has good fertility and has adequate soil moisture during the pod filling portion of the growing season. Lower plant populations reduce the occurrence of lodging but contribute to low pod set and excessive branching. Seeding rates should be increased (5-7%) to compensate for unavoidable plant thinning such as with rotary hoeing for early season weed control.

Weed Control: Control of early weeds is one of the most critical components of a profitable soybean production system. Weed control during the first 2 to 4 weeks of the growing season is essential to maximize yield. Good cultural practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, use of good quality, high germination seed free of weed seeds all contribute to a soybean crop that will compete with weeds. Finish seedbed preparation immediately prior to planting the crop to kill germinating weeds. Many herbicides are available for weed control in soybean. Most are currently labeled for tank mixing with other herbicides for broad spectrum weed control. A number of commercial herbicide mixtures also are available for use in soybean. Soybean is susceptible to injury from 2,4-D, MCPA, dicamba (Banvel), and picloram (Tordon) therefore; non-labeled herbicide drift or carryover into soybean fields should be avoided. Keep in mind the susceptibility of future rotation crops when choosing a soybean weed control strategy. Always read and follow pesticide label directions.

Irrigation: Successful soybean production in South Central Montana will require irrigation. Our normal growing season precipitation is not sufficient to support a productive soybean plant. Normally, irrigation, or high amounts of rainfall during vegetative growth, is not beneficial, except when soil water levels are extremely low. In fact, excessive water during the early growth stages may stimulate vegetative growth and increase the potential for lodging with either no increase in yield or a yield decrease. The most important times for soybean plants to have adequate available water are during pod development and seed fill. Irrigation may also be required during the flowering stage on sandy soils or during very dry years on medium and fine-textured soils. However, if water is applied during flowering, it is important to follow with adequate water during seed fill. Otherwise, more but smaller seeds will develop, reducing yields. Although soybean roots can reach depths of 5 to 6 feet, the largest concentration of roots and the

majority of soil water extraction occur in the top 2 to 3 feet of the soil profile. Therefore, irrigation water should not normally penetrate below 3 feet. Soybean produce highest yields on soils with good internal and surface drainage. For soybeans, between 10 and 11 inches of water are required from full flower to beginning maturity. Therefore, effective irrigation plus rainfall should equal about 3 inches during full flower, 3 inches during pod development and 4.5 inches during seed fill. If irrigation is started or unusually significant rainfall occurs during the beginning flower stage, it is especially important adequate soil water (50 percent available soil water or greater) be maintained during the remainder of the growing season. If you are limited in the amount of irrigation water you can apply during the season, you will get the maximum benefit of this water if it is applied during the pod development and seed fill growth stages. However, when the rainfall is below normal during the vegetative and flower stages, a yield reduction may occur. SARC trials have been flood irrigated 5 times, 2-3 weeks apart.

Harvesting: Timely, careful harvesting means extra bushels of soybean. Soybean is easy to thresh, but the challenge is to get all the soybean seed into the combine. Straight combining is the most satisfactory and commonly used method of harvest. Swathing soybean can result in excessive field losses (up to 25%) due to shattering. Use of equipment like floating headers, pickup reels, Love bars and row crop headers are helpful in reducing harvest losses. Use a reel speed about 25 percent faster than ground speed. Operate the cutterbar as close to the ground as possible at all times. Keep forward speeds at or below 3 miles per hour. Slow down if stubble is high and ragged, or if separating losses are high. Approximately four beans or one to two pods per square foot represent a yield loss of "one bushel" per acre. Harvest soybean when the plants are mature and the beans have approximately 14 percent moisture. Harvest may be started at 17 to 18 percent moisture when air drying is available. Harvest as much of the crop as possible above 12 percent moisture to avoid cracking seed coats and "splits". Soybean should be stored at 12-13% moisture.

Compiled by Paul Dixon, former Yellowstone County Extension Agent, from the following sources: SARC Soybean Adaptation and Performance Trials 1999-2000, Ken Kephart, Superintendent and Project Leader. Soybean Fact Sheet, compiled by Peggy Lamb, SARC Research Assoc. Conversation with Barry Jacobsen, MSU Plant Pathology Specialist. NDSU Extension Publication A-250, Berglund and Helms. University of Nebraska Extension Publication G98-1367-A, Benham, et.al.

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